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Soil Report

Lake Mountain and Middle Tompkins Allotment Management Plan Project

Scott River and Oak Knoll Ranger Districts, Klamath National Forest
Siskiyou County, California

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Executive Summary

Methodology and Analysis Indicators

A selection strategy was used to determine which areas should have site-specific data collected. Selection was based on soil sensitivity and level of range use. Soils with high erosion and displacement hazard ratings and low productivity were prioritized as well as areas of moderate and high range use. Field investigation was done by traversing across a moderate or high use area. Site and soil data were collected from plots along these traverses. The following types of existing site conditions were identified in the field during the traverses: soil cover, soil displacement, soil erosion, wet meadow damage, and soil indicator condition. Soil data noted in the field included shallow soil areas, rock outcrop, areas of surface rock, rock lithology and general soil depth. Existing soil survey information was used unless field investigation revealed significant differences between mapped soils and the actual site-specific soils.

The effects of individual management activities on the soil resource (soil productivity and soil ecosystem functionality) is guided using the Klamath National Forest's LRMP Standards and Guidelines and FSM 2500, Chapter 2550, Supplement 2500-2012-1. Three indicators were chosen that best address relevant issues in the Project and measure compliance with Forest Plan Standard and Guidelines. The indicators include soil stability, soil organic matter, and soil structure.

The measures for indicator conditions are: "good" (meets desired condition), "fair" (partially meets desired condition), or "poor" (does not meet desired conditions). A full description of what constitutes desired conditions for each of the soil indicators is described in the Project Soil Report. A qualitative rating for soil stability, soil organic matter, and soil structure were given to each alternative based on results from monitoring and professional judgment.

Spatial and Temporal Context

The analysis area for the soil resource is the 24,868 acre project area including the original allotment boundaries and proposed allotment boundaries of the Middle Tompkins and Lake Mountain Allotments. The analysis is further bounded in time by the foreseeable future period during which effects of this project could persist as detectable effects. Soil cover, as it affects soil stability, can recover quickly as needles and other organic debris is deposited on the forest floor. The temporal boundary for soil stability is 5 years. Soil organic matter can take years to decades to rebuild after it is lost through displacement or erosion. Once compacted, structure, and macroporosity can remain affected for decades. The temporal boundary for soil organic matter and soil structure is 30 years.

Affected Environment

Soils in the project area have developed from metamorphic, granitic, and ultramafic parent materials. Metamorphic soils typically have surface textures of gravelly or very gravelly loams, moderate compaction hazard ratings, high erosion hazard ratings, and moderate displacement

hazard ratings. Granitic soils typically have surface textures of sandy loams, low compaction hazard ratings, very high erosion hazard ratings, and high displacement hazard ratings. Ultramafic soils typically have surface textures of very gravelly loams, moderate compaction hazard ratings, high erosion hazard ratings, and low displacement hazard ratings. Productivity ratings range from high to non-productive. The most productive sites are deep metamorphic soils and the least productive sites are shallow granitic and ultramafic soils.

Four transects were run to survey for existing soil conditions. Results from the survey indicate a range in soil conditions. A high use site on the Middle Tompkins Allotment that had not been grazed recently and a moderate use site on the Lake Mountain Allotment had soil stability, soil organic matter, and soil structure rated as “good”. A second moderate use site on the Lake Mountain Allotment had minor amounts of soil organic matter displacement and elevated levels of bare soil resulting in “fair” soil indicator ratings. A high use site on the Lake Mountain Allotment had moderate amounts of organic matter displacement, wet meadow damage, and elevated levels of bare soil resulting in a “fair” rating for soil stability and soil organic matter and a “poor” rating for soil structure. A full description of results from this survey is found in the Project Soil Report.

In the fall of 2014, field visits were completed to re-evaluate sites that were monitored during the soil condition assessment to determine how the fire changed the affected environment in the project area. High use areas in the Middle Tompkins Allotment as well as moderate and high use areas in the Lake Mountain Allotment were evaluated for changes to soil cover and soil erosion as a result of the fire and subsequent rain events. The high use meadow areas were mostly just singed with scattered small pockets of moderate soil burn severity. Soil cover was reduced slightly in the meadows but no signs of erosion were present. Most of the trees surrounding the north side of Middle Creek Meadows were killed in the fire, but needle cast provided high levels of soil cover. The moderate use area off of Lake Mountain Lookout road was unburned due to the sparse fuels. Small patches of low soil burn severity were scattered around the Lake Mountain Spring and wet meadow. It was determined that the indicator condition assessment completed before the Happy Camp Fire was valid and was not changed.

Environmental Consequences

Alternative 1- No Action

Direct Effects and Indirect Effects

Direct effects of the No Action alternative would be of no effect on the soils, as soil disturbing project activities would not take place. Indirectly, soil stability, soil organic matter, and soil structure indicators would improve to the greatest extent under Alternative 1 with the elimination of livestock impacts, particularly in areas currently subjected to high use around wet meadows and springs. Soil hydrologic and ecological functions of these presently impacted areas would improve over the short- and long-term due to these enhanced soil conditions. Improvement of soil conditions in light and moderate use areas would be less dramatic. Grazing impacts related to wildlife would be unaffected. Elimination of livestock grazing would promote the recovery of existing wet meadow and spring trampling effects in the short- and long-term. Ground cover

would be maximized and thus contribute to lowered risk of accelerated soil erosion within the grazing allotments.

This alternative would satisfy the Forest-wide Standard and Goal 3-1 to maintain or enhance soil productivity and stability. In addition, Forest Standard and Guidelines 3-3 through 3-5 dealing with retention of organic matter would be satisfied. By meeting desired conditions for soil stability, soil organic matter, and soil structure, Alternative 1 will result in “good” soil indicator ratings.

Cumulative Effects

Numerous past actions, including timber harvesting, wildfire, and grazing, occurred in the allotments. Effects of past projects are incorporated in the affected environment section of this report. Ongoing and future foreseeable actions in the project area include hazard tree removal and fuels reduction projects. Impacts to soil functions from these activities will be minor. Additionally, the Westside Fire Recovery Project is a future action that proposes salvage logging, roadside hazard reduction, fuels reduction, and reforestation within the Lake Mountain and Middle Tompkins AMP Project area. These projects include PDFs designed to minimize impacts to soil productivity and stability.

Under Alternative 1, soil indicators are likely to meet or move toward desired conditions. Because grazing would be precluded on the allotments and there would be no direct or indirect effects on the soil resource, there would be no cumulative effects to the soil resource.

Alternative 2-Proposed Action

Direct Effects and Indirect Effects

Soil condition indicators are expected to improve in Alternative 2 compared to current management, though improvements will occur more slowly than under the No Action Alternative. Long-term rangeland monitoring shows that key areas are meeting or moving toward desired conditions in both allotments. This trend is expected to continue under this alternative because the alternative includes adaptive management actions that can be implemented if design criteria are not being met. The Proposed Action includes proactive herd management that will move cattle when utilization levels are approaching standards. In addition, this alternative proposes monitoring and management actions that can be used to meet utilization standards.

To allow for post-fire recovery of vegetation and fore recovery activities (e.g., fire salvage harvest, hazard tree abatement, ground preparation and tree re-planting), livestock use will be modified within the Project area. For Middle Tompkins allotment, livestock will not be authorized until 2016. Lake Mountain allotment will be grazed in 2015, but animals may be turned out at a later date and/or the season may be shortened in the fall. These modifications will allow the post-fire flush new vegetation to become established before allowing grazing. Established vegetative cover will help protect the soil from impacts of grazing and increase the likelihood of meeting desired conditions for the soil analysis indicators.

Under Alternative 2, range readiness evaluation will be used to reduce the negative impacts of cattle grazing on saturated soils. Range readiness will be determined prior to annual entry into allotments or units within allotments by key species phenology and soil conditions. Soils will be firm on dry meadows and other dry feed areas. Moist meadows should be for the most part dry enough to carry stock without breaking sod and destroying vegetative cover.

Desired conditions for soil stability, soil organic matter, and soil structure would be sustained or improved under Alternative 2 due to the adoption of a proposed adaptive management system. The adaptive management system will include allowable use standard monitoring and long term ecological conditions monitoring protocols to determine the need for actions to reduce impacts from grazing. A number of actions including reducing Head Months (HM's), resting affected areas, building exclosure fences, improved salt/supplement, changing grazing systems, developing water sources, and changing the timing cattle are permitted to graze an area are all tools in the AMS toolbox.

Also proposed under Alternative 2, the redevelopment of the Lookout Spring in the Lake Mountain Allotment with construction of an exclosure around the springhead and seep will improve soil conditions. Grazing at this site has led to trampling of saturated soils which has impacted soil hydrologic and ecological functions. Redirecting cattle and excluding cattle from the most sensitive areas will improve soil structure condition rating from "poor" to "fair".

Alternative 2 would satisfy the Forest-wide Standard and Goal 3-1 to maintain or enhance soil productivity and stability. In addition, Forest Standard and Guidelines 3-3 through 3-5 dealing with retention of organic matter would be satisfied. Under Alternative 2, soil indicators are likely to meet or move toward desired conditions through adoption of AMS and development and exclosure of Lookout Spring. Desired conditions for soil stability, soil organic matter, and soil structure, remain the same or improve compared to current management. Alternative 2 will result in "good" to "fair" soil indicator ratings.

Cumulative Effects

Numerous past actions, including timber harvesting, wildfire, and grazing, occurred in the allotments. Effects of past projects are incorporated in the affected environment section of this report. Ongoing and future foreseeable actions in the project area include hazard tree removal and fuels reduction projects. Impacts to soil function from these activities will be minor. Additionally, the Westside Fire Recovery Project is a future action that proposes salvage logging, roadside hazard reduction, fuels reduction, and reforestation within the Lake Mountain and Middle Tompkins AMP Project area. These projects include PDFs designed to minimize impacts to soil productivity and stability.

Under Alternative 2, soil indicators are likely to meet or move toward desired conditions through adoption of AMS and development and an exclosure of Lookout Spring. Adding the effects of Alternative 2 to the effects of past, present, and reasonably foreseeable future actions is not expected to have measurable effects on soil condition indicators, therefore, no significant effects will occur.

Alternative 3

Direct Effects and Indirect Effects

The current management situation is similar to that of Alternative 2 except that monitoring would be more limited and management actions would be limited to those allowable under the current permit. In addition, the trampling of saturated soils at Lookout Springs would not be addressed with fencing and the spring redevelopment.

Similar to Alternative 1, Alternative 3 will improve the soil condition indicators in the Middle Tompkins Allotment because this allotment would remain vacant. Previous grazing impacts to soil stability, soil organic matter, and soil structure indicators would improve over time by continuing to restrict grazing in this allotment.

Alternative 3 will not improve soil condition indicators in the Lake Mountain Allotment as effectively as Alternative 2. The impacts of trampling around Lookout Spring will not be reduced through exclosure and spring development. An adaptive management system would not be in place which will reduce the tools available to the range manager to address impacts from grazing. The poor rating for soil structure at Lookout Springs will need to be addressed through actions allowable under the current permit.

Alternative 3 would satisfy the Forest-wide Standard and Goal 3-1 to maintain or enhance soil productivity and stability. In addition, Forest Standard and Guidelines 3-3 through 3-5 dealing with retention of organic matter would be satisfied. Desired conditions for soil stability, soil organic matter, and soil structure, remain the same or improve. Improvements to desired conditions will occur more slowly than Alternative 2 without the use of the AMS tools available to range managers to address impacts from grazing. Alternative 3 will result in “good” to “fair” soil indicator ratings.

Cumulative Effects

The cumulative effects of Alternative 3 are the same as Alternative 2. Under Alternative 3, soil indicators are likely to meet or move toward desired conditions through actions allowable under the current permit. Adding the effects of Alternative 2 to the effects of past, present, and reasonably foreseeable future actions is not expected to have measurable effects on soil condition indicators, therefore, no significant effects will occur.

Summary of Effects

All alternatives would satisfy the Forest-wide Standard and Goal 3-1 to maintain or enhance soil productivity and stability. In addition, Forest Standard and Guidelines 3-3 through 3-5 dealing with retention of organic matter would be satisfied. By meeting desired conditions for soil stability, soil organic matter, and soil structure, Alternative 1 will result in “good” soil indicator ratings.

Under Alternative 2, soil indicators are likely to meet or move toward desired conditions through adoption of AMS and development and exclosure of Lookout Spring. Desired conditions for soil

stability, soil organic matter, and soil structure, will remain the same or improve compared to current management. Alternative 2 will result in “good to fair” soil indicator ratings.

Under Alternative 3, soil indicators are likely to meet or move toward desired conditions through actions allowable under the current permit. Desired conditions for soil stability, soil organic matter, and soil structure, will remain the same or improve. Improvements to desired conditions will occur more slowly than Alternative 2 without the use of the AMS tools available to range managers to address impacts from grazing. Alternative 3 will result in “good to fair” soil indicator ratings.

Compliance with law, regulation, policy, and the Forest Plan

Forest Plan Standards and Guidelines for soils will be met for all alternatives by maintaining or enhancing soil productivity and stability. All alternatives will meet or partially meet desired conditions for soil structure, soil organic matter, and soil structure. Impacts from grazing are reduced to the extent possible with PDFs.

Soil Report

Introduction

This report analyzes impacts to soil indicators including soil stability, soil organic matter, and soil structure in the Lake Mountain and Middle Tompkins Allotment Management Plan (AMP) Project (Project). These soil indicators address how well the project maintains long-term soil productivity as defined in the Klamath National Forest's Land Resource Management Plan (LRMP) (USDA 2010), the Regional Soil Management supplement to Forest Service Manual (FSM) direction (FSM 2500-2012-1) (USDA 2012). Potential impacts to soil functions are analyzed and mitigated through project design features (PDFs) and best management practices (BMPs).

The project area encompasses approximately 24,868 acres and straddles the Oak Knoll and Scott River District boundary of the Klamath National Forest west of Scott Bar, California in Siskiyou County. The legal locations are T44N, R11W, Sections 3-10, 16-18; T44N, R12W Sections 1,12,13; T45N, R11W, Sections 2-5, 8-11, 14-18, 19-23, 26-34; T45N, R12W, Section 25, 36; T46N, R11W Sections 17, 20, 21, 26-29, 32-36, Mt. Diablo Meridian. Private land accounts for about 473 acres within the project boundary, leaving about 24,395 acres that may be authorized for grazing on National Forest System lands.

This report discloses effects anticipated as a result of the Lake Mountain and Middle Tompkins AMP Project. For a complete description of the project purpose and need and alternatives analyzed, please refer to the *Lake Mountain and Middle Tompkins Allotment Management Plan Project* (EA). A complete list of PDFs applicable to all resources is included in the alternative description within the EA.

Proposed Actions and Alternatives Analyzed

For a detailed description of the alternatives considered for analysis, see Chapter 2 of the EA. In summary, three alternatives are analyzed in this report: Alternative 1 – No Action, Alternative 2 – Proposed Action, and Alternative 3 – Current Management.

Methodology

Detailed Methodology

A selection strategy was used to determine which areas should have site-specific data collected. Selection was based on soil sensitivity and level of range use. Soils with high erosion and displacement hazard ratings and low productivity were prioritized as well as areas of moderate and high range use. A description of the methodology used for determining erosion and displacement risk ratings as well as soil productivity rating is in Appendix A. Field investigation was done by traversing across a moderate or high use area. Site and soil data were collected from plots along these traverses. The following types of existing site conditions were identified in the field during the traverses: soil cover, soil displacement, soil erosion, wet meadow soil disturbance, and soil indicator condition. Soil data noted in the field included shallow soil areas,

rock outcrop, areas of surface rock, rock lithology and general soil depth. Existing soil survey information (Foster and Lang 1994) was used unless field investigation revealed significant differences between mapped soils and the actual site-specific soils. Maps of soil condition transects along with use levels can be found in Appendix D. Data collected from soil condition transects are presented in Table 5.

Analysis Indicators

The effects of individual management activities on the soil resource (soil productivity and soil ecosystem functionality) is guided using the Klamath National Forest's LRMP Standards and Guidelines and FSM 2500, Chapter 2550, Supplement 2500-2012-1. Three indicators were chosen that best address relevant issues in the Project and measure compliance with Forest Plan Standard and Guidelines. The indicators include soil stability, soil organic matter, and soil structure.

The measures for indicator conditions are: "good" (meets desired condition), "fair" (partially meets desired condition), or "poor" (does not meet desired conditions). Table 2 describes what constitutes desired conditions for each of the soil indicators. A qualitative rating for soil stability, soil organic matter, and soil structure were given to each alternative based on results from monitoring and professional judgment.

Table 1. Indicator Condition Assessment

Soil Function	Indicators	Indicator Conditions		
		Good	Fair	Poor
		Meets Desired Condition	Partially Meets Desired Condition	Does Not Meet Desired Condition
Support for Plant Growth and Soil Hydrologic Functions	Soil Stability	An adequate level of soil cover is present and signs of erosion are not visible or very limited in degree and extent. Any existing erosion control measures are effective. Generally soil cover level is 50% or greater and is well distributed for soil types capable of supporting this level.	For minor portions of the area, soil cover is lacking and/or existing erosion control measures are ineffective and there are signs of erosion such as pedestals, sheet, rill, and/or gully erosion visible	Major portions of the area lack soil cover and/or lack effective erosion control measures. Signs of erosion such as pedestals, sheet, rill, and/or gully erosion are common.
Support for Plant Growth	Soil Organic Matter (SOM)	The thickness and color of the upper soil layer is within the normal range of characteristics for the site and is distributed normally across the area. Localized areas of displacement may have occurred but it will not affect the productivity for	For minor portions of the area, the upper soil layer has been displaced or removed to a depth and area large enough to affect productivity for the desired plant species. Generally an area will be considered displaced if more than one-half of the upper	Major portions of the area have had the upper soil layer displaced or removed to a depth and area large enough to affect productivity for the desired plant species.

		the desired plant species.	soil layer or 4 inches (whichever is less) is removed from a contiguous area larger than 100 sq. ft.	
Soil Hydrologic Function	Soil Structure	Visually soil structure and macro-porosity (defined here as pores 1mm or larger) are relatively unchanged from natural condition for nearly all the area. Signs of erosion or overland flow are absent or very limited in degree and extent. Infiltration and permeability capacity of the soil is sufficient for the local climate.	For minor portions of the area: soil structure and macro-porosity are changed; or platy structure and/or increased density evident; or overland flow and signs of erosion are visible. Infiltration and permeability capacity is insufficient in localized portions of the area.	Major portions of the area have reduced infiltration and permeability capacity indicated by soil structure and macro-porosity changes; or platy structure and/or increased density; or signs of overland flow and erosion.

Spatial and Temporal Bounding of Analysis Area

The analysis area for the soil resources is the 24,868 acre project area including the original allotment boundaries and proposed allotment boundaries of the Middle Tompkins and Lake Mountain allotments. The analysis is further bounded in time by the foreseeable future period during which effects of this project could persist as detectable effects. Soil cover, as it affects soil stability, can recover quickly as needles and other organic debris is deposited on the forest floor. The temporal boundary for soil stability is 5 years. Soil organic matter can take years to decades to rebuild after it is lost through displacement or erosion. Once compacted, structure, and macroporosity can remain affected for decades. The temporal boundary for soil organic matter and soil structure is 30 years.

Affected Environment

Soils in the project area have developed from metamorphic, granitic, and ultramafic parent materials. Metamorphic soils typically have surface textures of gravelly or very gravelly loams, moderate compaction hazard ratings, high erosion hazard ratings, and moderate displacement hazard ratings. Granitic soils typically have surface textures of sandy loams, low compaction hazard ratings, very high erosion hazard ratings, and high displacement hazard ratings. Ultramafic soils typically have surface textures of very gravelly loams, moderate compaction hazard ratings, high erosion hazard ratings, and low displacement hazard ratings. Productivity ratings range from high to non-productive. The most productive sites are deep metamorphic soils and the least productive sites are shallow granitic and ultramafic soils. A soil map of Middle Tompkins and Lake Mountain allotments can be found in Appendix B. Soil map unit characteristics and interpretations are found in Appendix C.

Transect 1 on the Middle Tompkins Allotment is a high use area with 5% bare soil, no organic matter displacement, erosion, or wet meadow damage. Soil stability, soil organic matter, and soil structure are rated as “good” at this site.



Figure 1. Transect 1 in a High Use Area in the Middle Tompkins Allotment

Transect 2 near Browns Knob on the Lake Mountain Allotment is a moderate use area with 22% bare soil, no organic matter displacement, erosion, or wet meadow soil disturbance. The elevated level of bare soil is due to the ultramafic soils with sparse vegetative cover. Soil stability, soil organic matter, and soil structure are rated as “good” at this site.



Figure 2. Transect 2 in Moderate Use Area in the Lake Mountain Allotment

Transect 3 near Lake Mountain Lookout is a moderate use area with 25% bare soil, minor organic matter displacement, and no erosion. No wet meadow is present at this site. Soil stability, soil organic matter, and soil structure are rated as Fair at this site.



Figure 3. Transect 3 in Moderate Use Area in the Lake Mountain Allotment

Transect 4 near Lake Mountain Lookout is a high use area with 25% bare soil, moderate organic matter displacement, no erosion, and moderate wet meadow soil disturbance. Soil stability and soil organic matter are rated as fair, and soil structure is rated as poor at this site.



Figure 4. Transect 4 in High Use Area in the Lake Mountain Allotment

Table 2. Results of Soil Condition Assessment of Middle Tompkins and Lake Mountain Allotments

Transect #	Use level	Soil Map Unit	Location	% bare soil	Soil Organic Matter displaced	Erosion	Wet meadow Damage ?	Indicator Condition Assessment
1	High	141	Middle Creek Meadow	5%	None	None	None	Good. Very little damage to meadow from grazing. No trampling, no hoof prints in wet part of the meadow. No signs of erosion.
2	Moderate	150/171	Browns Knob	22%	None	None	None	Good. Peridotite soils with areas of naturally bare soil. Gofer activity is high which also contributes to bare soil. Small meadow of .5 acre in area does not have hoof prints
3	Moderate	150/162	Lake Mtn Road	25%	Minor	None	NA	Fair. High use in dry meadow, light in surround forested area. Soil disturbance is approximately 10% of the dry meadow
4	High	123	Lake Mtn Spring and meadow	25%	Moderate	None	Moderate	Poor-fair. Poor conditions exist on steep slopes in meadow near springs and seeps, where wet soil can't hold up to trampling. Flatter, dryer areas of the meadow are in fair condition with only minor disturbance

2014 Happy Camp Complex Fire

The Happy Camp Complex Fire burned approximately 117,000 acres in summer 2014 upon three Ranger Districts of the Klamath National Forest. The entirety of both allotments comprising the Project area was affected. In general, the Project area experienced a mosaic burn, with most locales exhibiting either low burn severity or no burn, with vegetation expected to return to pre-fire condition within a few years. Locales of moderate and high burn severity are also present.

According to the Happy Camp Burned Area Emergency Response (BAER) report 77 percent of the soils in the fire area burned at low or very low severity showing very little evidence of significant soil heating with essentially no changes in soil color, structure, organic matter or fine root combustion (USDA 2014). Moderate soil burn severity was report at 22 percent of the burn area where soil heating was generally not hot enough to alter soil structure or fine roots in the topsoil. High soil burn severity was report at only 1 percent of the fire area. These areas have deeper soil heating effects and compromised soil structure and organic matter, leading to higher erosion hazard and slower natural recovery.

In the fall of 2014, field visits were completed to re-evaluate sites that were monitored during the soil condition assessment to determine how the fire changed the affected environment in the project area. High use areas in the Middle Tompkins Allotment as well as moderate and high use areas in the Lake Mountain Allotment were evaluated for changes to soil cover and soil erosion as a result of the fire and subsequent rain events. The high use meadow areas were mostly just singed with scattered small pockets of moderate soil burn severity. Soil cover was reduced slightly in the meadows but no signs of erosion were present. Most of the trees surrounding the north side of Middle Creek Meadows were killed in the fire, but needle cast provided high levels of soil cover. The moderate use area off of Lake Mountain Lookout road was unburned due to the sparse fuels. Small patches of low soil burn severity were scattered around the Lake Mountain Spring and wet meadow. It was determined that the indicator condition assessment completed before the Happy Camp Fire was valid and was not changed.

Environmental Consequences

Alternative 1 – No Action

Direct Effects and Indirect Effects

Direct effects of the No Action alternative would be of no effect on the soils, as soil disturbing project activities would not take place. Indirectly, soil stability, soil organic matter, and soil structure indicators would improve to the greatest extent under Alternative 1 with the elimination of livestock impacts, particularly in areas currently subjected to high use around wet meadows and springs. Soil hydrologic and ecological functions of these presently impacted areas would improve over the short- and long-term due to these enhanced soil conditions. Improvement of soil conditions in light and moderate use areas would be less dramatic. Grazing impacts related to wildlife would be unaffected. Elimination of livestock grazing would promote the recovery of existing wet meadow and spring trampling effects in the short- and long-term. Ground cover would be maximized and thus contribute to lowered risk of accelerated soil erosion within the grazing allotments.

This alternative would satisfy the Forest-wide Standard and Goal 3-1 to maintain or enhance soil productivity and stability. In addition, Forest Standard and Guidelines 3-3 through 3-5 dealing with retention of organic matter would be satisfied. By meeting desired conditions for soil

stability, soil organic matter, and soil structure, Alternative 1 will result in “good” soil indicator ratings.

Cumulative Effects

Numerous past actions, including timber harvesting, wildfire, and grazing, occurred in the allotments. Effects of past projects are incorporated in the affected environment section of this report. Ongoing and future foreseeable actions in the project area include hazard tree removal and fuels reduction projects. Additionally, the Westside Fire Recovery Project is a future action that proposes salvage logging, roadside hazard reduction, fuels reduction, and reforestation within the Lake Mountain and Middle Tompkins AMP Project area. These projects include PDFs designed to minimize impacts to soil productivity and stability.

Under Alternative 1, soil indicators are likely to meet or move toward desired conditions. Because grazing would be precluded on the allotments and there would be no direct or indirect effects on the soil resource, there would be no cumulative effects to the soil resource.

Alternative 2 – Proposed Action

See Chapter 2 of the EA for a full description of the proposed action as well as a list of PDFs.

Direct and Indirect Effects

Soil condition indicators are expected to improve in Alternative 2 compared to current management, though improvements will occur more slowly than under the No Action Alternative. Long-term rangeland monitoring shows that key areas are meeting or moving toward desired conditions in both allotments for the soil analysis indicators. This trend is expected to continue under this alternative because the alternative includes adaptive management actions that can be implemented if design criteria are not being met. The Proposed Action includes proactive herd management that will move cattle when utilization levels are approaching standards. In addition, this alternative proposes monitoring and management actions that can be used if necessary to meet utilization standards.

To allow for post-fire recovery of vegetation and silvicultural activities (e.g., fire salvage harvest, hazard tree abatement, ground preparation and tree re-planting), livestock use will be modified within the Project area (McMorris, pers. comm.). For Middle Tompkins allotment, livestock will not be authorized until 2016. Lake Mountain allotment will be grazed in 2015, but animals may be turned out at a later date and/or the season may be shortened in the fall. These modifications will allow the post-fire flush new vegetation to become established before allowing grazing. Established vegetative cover will help protect the soil from impacts of grazing and increase the likelihood of meeting desired conditions for the soil analysis indicators.

Under Alternative 2, range readiness evaluation will be used to reduce the negative impacts of cattle grazing on saturated soils. Range readiness will be determined prior to annual entry into allotments or units within allotments by key species phenology and soil conditions. Soils will be firm on dry meadows and other dry feed areas. Moist meadows should be for the most part dry enough to carry stock without breaking sod and destroying vegetative cover.

Desired conditions for soil stability, soil organic matter, and soil structure would be sustained or improved under Alternative 2 due to the adoption of a proposed adaptive management system. The adaptive management system will include allowable use standard monitoring and long term ecological conditions monitoring protocols to determine the need for actions to reduce impacts from grazing. A number of actions including reducing Head Months (HM's), resting affected areas, building enclosure fences, improved salt/supplement, changing grazing systems, developing water sources, and changing the timing cattle are permitted to graze an area are all tools in the AMS toolbox.

Also proposed under Alternative 2, the redevelopment of the Lookout Spring in the Lake Mountain Allotment with construction of an enclosure around the springhead and seep will improve soil conditions. Grazing at this site has led to trampling of saturated soils which has impacted soil hydrologic and ecological functions. Redirecting cattle and excluding cattle from the most sensitive areas will improve soil structure condition rating from poor to fair.

Alternative 2 would satisfy the Forest-wide Standard and Goal 3-1 to maintain or enhance soil productivity and stability. In addition, Forest Standard and Guidelines 3-3 through 3-5 dealing with retention of organic matter would be satisfied. Desired conditions for soil stability, soil organic matter, and soil structure remain the same or improve compared to current management. Alternative 2 will result in "good to fair" soil indicator ratings.

Cumulative Effects

Numerous past actions, including timber harvesting, wildfire, and grazing, occurred in the allotments. Effects of past projects are incorporated in the affected environment section of this report. Ongoing and future foreseeable actions in the project area include hazard tree removal and fuels reduction projects. The impacts to soil function from these activities will be minor. Additionally, the Westside Fire Recovery Project is a future action that proposes salvage logging, roadside hazard reduction, fuels reduction, and reforestation within the Lake Mountain and Middle Tompkins AMP Project area. These projects include PDFs designed to minimize impacts to soil productivity and stability.

Under Alternative 2, soil indicators are likely to meet or move toward desired conditions through adoption of AMS and development and an enclosure of Lookout Spring. Adding the effects of Alternative 2 to the effects of past, present, and reasonably foreseeable future actions is not expected to have measurable effects on soil condition indicators, therefore, no significant effects will occur.

Alternative 3 –Current Management

Direct and Indirect Effects

The current management situation is similar to that of Alternative 2 except that monitoring would be more limited, and management actions would be limited to those allowable under the current permit. In addition, the trampling of saturated soils at Lookout Springs would not be addressed with exclosure fencing and spring redevelopment.

Similar to Alternative 1, Alternative 3 will improve the soil condition indicators in the Middle Tompkins Allotment because this allotment would remain vacant. Previous grazing impacts to soil stability, soil organic matter, and soil structure indicators would improve over time by continuing to restrict grazing in this allotment.

Alternative 3 will not improve soil condition indicators in the Lake Mountain Allotment as effectively as Alternative 2. The impacts of trampling around Lookout Spring will not be reduced through exclosure and spring development. An adaptive management system would not be in place which will reduce the tools available to the range manager to address impacts from grazing. The poor rating for soil structure at Lookout Springs will have to be addressed through actions allowable under the current permit.

Alternative 3 would satisfy the Forest-wide Standard and Goal 3-1 to maintain or enhance soil productivity and stability. In addition, Forest Standard and Guidelines 3-3 through 3-5 dealing with retention of organic matter would be satisfied. Desired conditions for soil stability, soil organic matter, and soil structure, remain the same or improve. Improvements to desired conditions will occur more slowly than Alternative 2 without the use of the AMS tools available to range managers to address impacts from grazing. Alternative 3 will result in “good to fair” soil indicator ratings.

Cumulative Effects

The cumulative effects of Alternative 3 are the same as Alternative 2. Under Alternative 3, soil indicators are likely to meet or move toward desired conditions through actions allowable under the current permit. Adding the effects of Alternative 2 to the effects of past, present, and reasonably foreseeable future actions is not expected to have measurable effects on soil condition indicators, therefore, no significant effects will occur.

Summary of Effects

All alternatives would satisfy the Forest-wide Standard and Goal 3-1 to maintain or enhance soil productivity and stability. In addition, Forest Standard and Guidelines 3-3 through 3-5 dealing with retention of organic matter would be satisfied. By meeting desired conditions for soil stability, soil organic matter, and soil structure, Alternative 1 will result in “good” soil indicator ratings.

Under Alternative 2, soil indicators are likely to meet or move toward desired conditions through adoption of AMS and development and exclosure of Lookout Spring. Desired conditions for soil stability, soil organic matter, and soil structure, will remain the same or improve compared to current management. Alternative 2 will result in “good to fair” soil indicator ratings.

Under Alternative 3, soil indicators are likely to meet or move toward desired conditions through actions allowable under the current permit. Desired conditions for soil stability, soil organic matter, and soil structure, will remain the same or improve. Improvements to desired conditions will occur more slowly than Alternative 2 without the use of the AMS tools available to range managers to address impacts from grazing. Alternative 3 will result in “good to fair” soil indicator ratings.

Compliance with law, regulation, policy, and the Forest Plan

Forest Plan Standards and Guidelines for soils will be met for all alternatives by maintaining or enhancing soil productivity and stability. All alternatives will meet or partially meet desired conditions for soil structure, soil organic matter, and soil structure. Impacts from grazing are reduced to the extent possible with PDFs.

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Appendix A – Rating and Risk Assessments

Rating and Risk Assessments

Soil Productivity Rating

Soil productivity is a measure of a sites capability to produce biomass. The purpose of this interpretation is to have the ability to estimate a soil's productive capability when site trees are not available or the vegetative biomass data is not available or on site (USDA 1990). Results of soil productivity rating for each soil map unit are in Table 6 in Appendix B.

Table 3. Guide for Estimating Soil Productivity

Factor					Rating
Soil Depth	>40 inches(1)	20 to 40 inches (3)	10 to 20 inches (5)	<10 inches(10)	
Parent Material	Volcanics, Alluvium, Meta-sediments, Meta-volcanics (1)	Granitics, Sandstone (2)	Serpentinite, Peridotite (4)		
Average Water Holding Capacity (inches) Total Profile	>7 inches (1)	5 to 7 inches (3)	2 to 5 inches (5)	< 2 inches (7)	
Precipitation	> 40 inches (1)	30 to 40 inches (3)	20 to 30 inches (5)	< 20 inches (12)	
Soil Temperature Regime	Thermic (2)	Mesic (0)	Frigid (1)	Cryic (3)	
Aspect	NW to NE (1)	NE to SE W to NW Flat (2)	SE to W (4)		
Reaction	4.5 to 7.8 (0)	> 7.8 or <4.5 (5)			

Numerical Rating	Soil Productivity Rating
5 - 9	High
10 - 16	Moderate
17 - 24	Low
> 24	Non-productive

Compaction Risk Rating

Compaction hazard is the susceptibility of the soil to compaction based upon soil properties. Seasonal fluctuations in susceptibility are likely as moisture content varies. A soil can have a severe compaction risk when moist, but have a slight risk when dry. This risk rating scheme is

intended to help determine general susceptibility to soil productivity loss from compaction. It considers the risk that compaction will occur, and if compaction would result in productivity loss. It is based upon soil texture and rock content. It presumes soil is at field capacity or a moisture level at which soil is most susceptible to density increase (USDA 2006). Results of compaction risk ratings for each soil map unit are in Table 6 in Appendix B.

Table 4. Compaction Risk Rating

Coarse Fragment Content by Volume	Soil Texture	Hazard Rating
Fragmental (> 70%)	Any Texture	Low
Skeletal (35 - 70%)	Sandy	Low
Skeletal (35 - 70%)	Loamy	Moderate
Skeletal (35 - 70%)	Clayey	High
< 35%	Sandy	Low
< 35%	Loamy	Moderate
< 35%	Silty	High
< 35%	Clayey	High

Erosion Risk Rating

The Region 5 Soil Erosion Hazard Rating (EHR) System was used to rate the risk of soil erosion for all soils in the project area. The Erosion Hazard Rating system is designed to appraise the relative risk of accelerated sheet and rill erosion. The system does not rate gully erosion, dry ravel, wind erosion or mass wasting. The purpose of the EHR system is to help, (1.) Evaluate the likelihood that a specific soil disturbing activity would cause accelerated sheet and rill erosion, (2.) Evaluate the relative risk for adverse consequences, and (3.) Identify approximate soil cover amounts needed to achieve an acceptable risk level (USDA 1990). Results of erosion hazard ratings for each soil map unit are in Table 6 in Appendix B.

Displacement Risk Rating

Displacement hazard is the susceptibility of the soil to displacement based on soil properties. The most limiting factors influencing the risk of soil displacement are sandy surface textures, few coarse fragments, weak soil structure, thin duff layer, and low bulk density (USDA 1990). Results of displacement hazard ratings for each soil map unit are in Table 6 in Appendix B.

Table 5. Displacement Risk Rating

Factors Affecting	Slight	Moderate	Severe
Texture of Surface	C, SIC, SC, SICL	L, CL, SIL, VFSL, FSL	SL and coarser
Organic carbon content (%) surface 6 inches	>6	2 - 6	<2
Thickness of duff	>3	1 - 3	<1
Coarse fragment content (%) by volume	45	25 - 45	<25
Structure of surface soil (grade and size)	--	Moderate, medium, coarse	single grain weak f, vf
Bulk density	--	0.8 to 1 g/cc	<0.8 g/cc
Cohesion	High cohesion	Medium cohesion	Low cohesion

Assumption: Ratings are based on dry soil conditions

Appendix B – Soil Maps of the Project Area

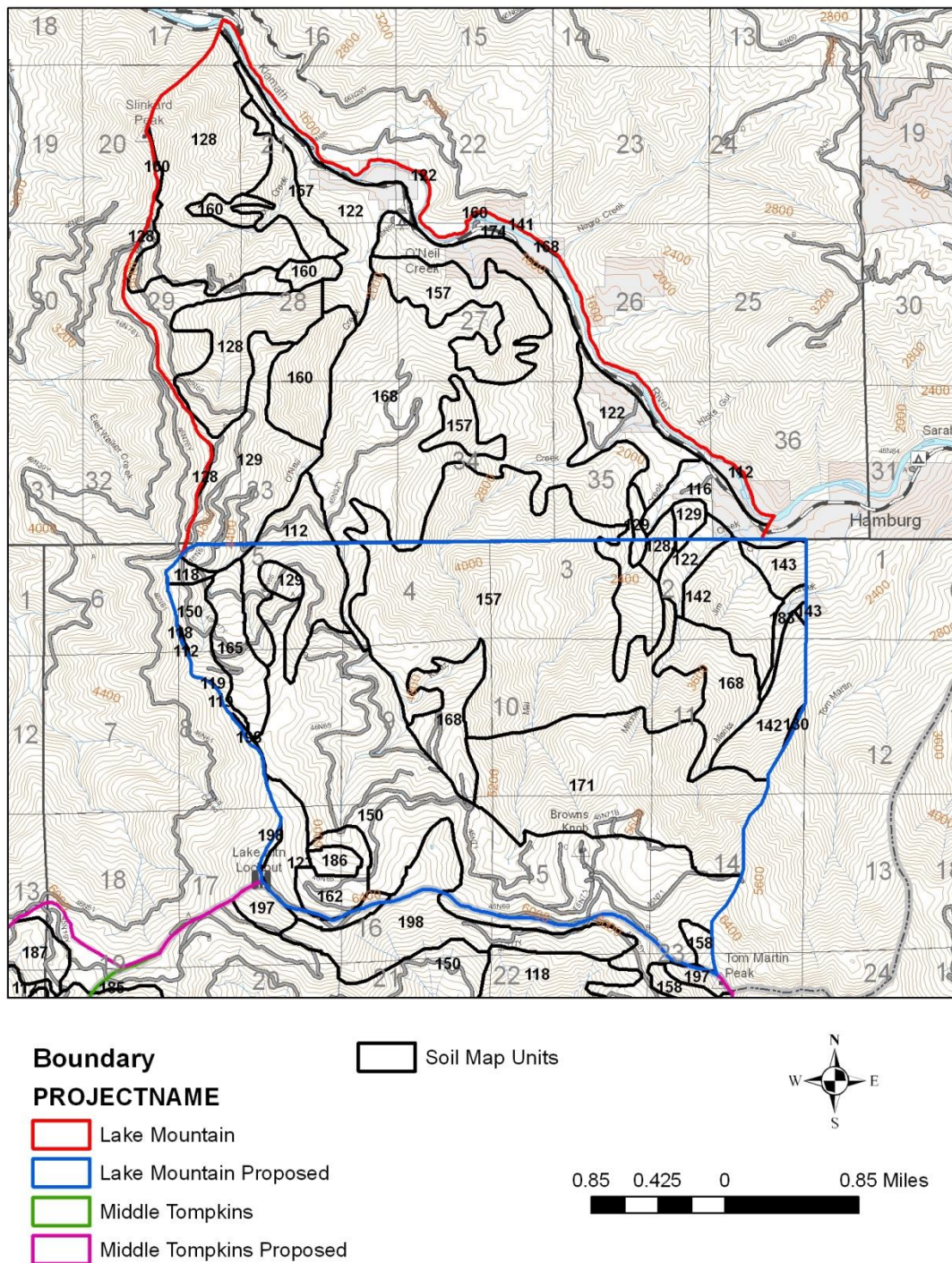


Figure 5. Soil Map of the Lake Mountain Allotment

Appendix B Continued – Soil Maps of the Project Area

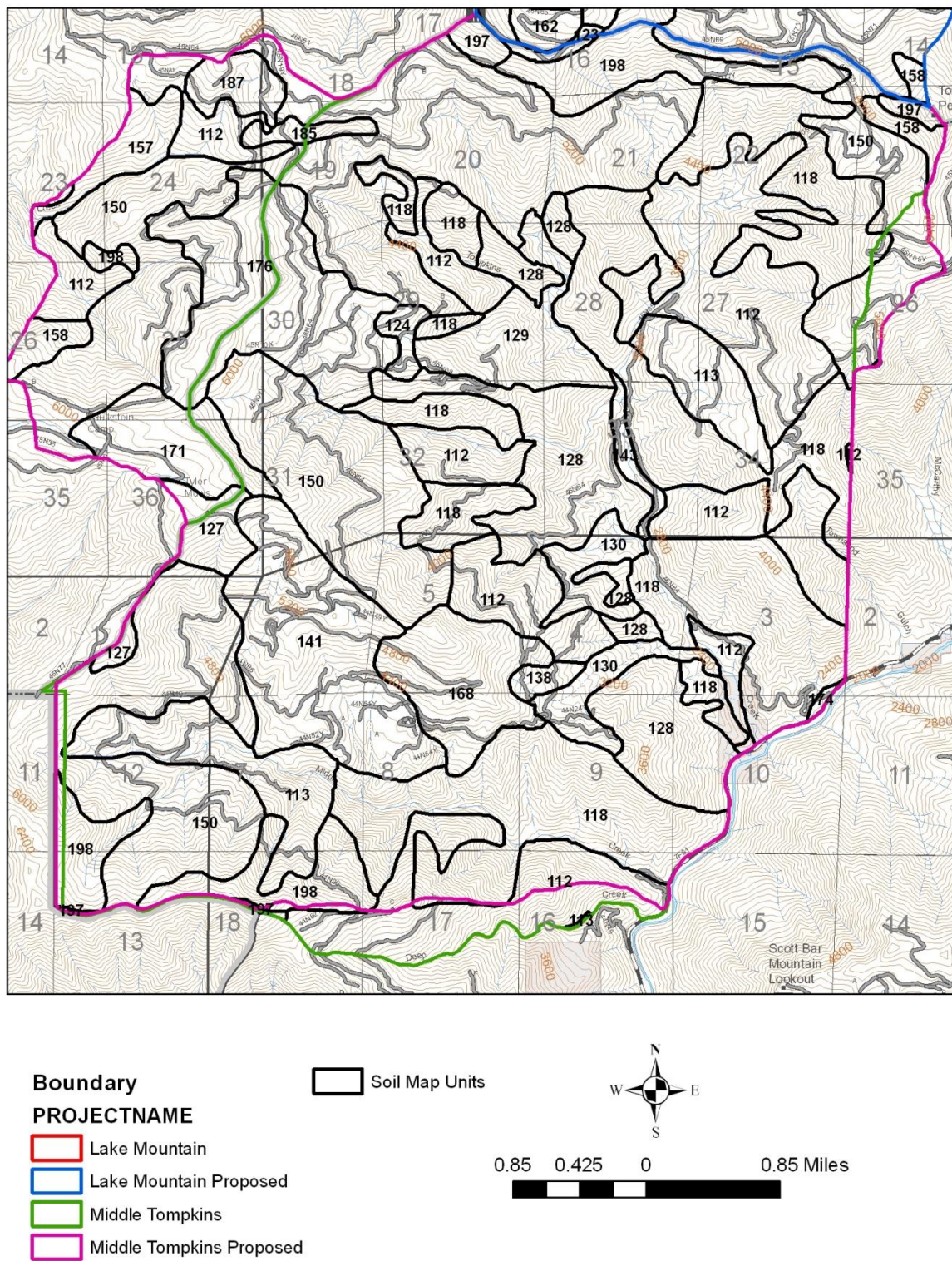


Figure 6. Soil Map of the Middle Tompkins Allotment

Appendix C – Soil Map Unit Characteristics and Interpretations

Table 6. Soil Map Unit Characteristics and Interpretations

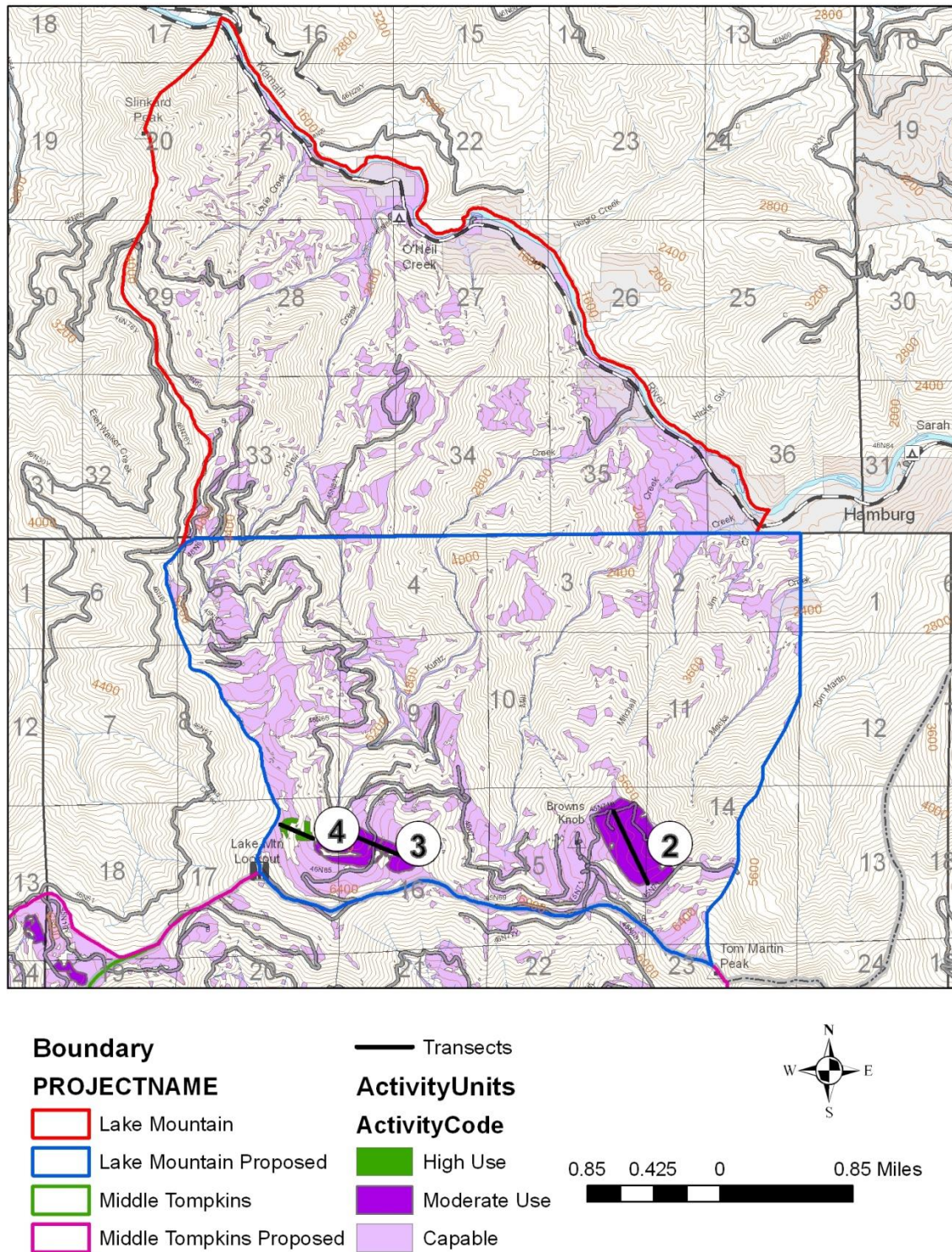
Soil Map Unit #	Soil Map Unit Name	Parent Material	Surface Texture	Soil Depth	Productivity Rating	Compaction Hazard Rating	Erosion Hazard Rating	Displacement Hazard Rating
112	Clallam, deep-Deadwood families assn., 50 to 90 % slopes	residuum weathered from metamorphic rock	very gravelly loam	107	M	M	H	L
113	Clallam, deep-Holland families assn., 30 to 70 % slopes	residuum weathered from metamorphic rock	very gravelly loam	107	M	M	H	L
116	Coboc-Holland families assn., 2 to 15 % slopes	alluvium derived from metamorphic rock and/or colluvium derived from metamorphic rock	gravelly loam	201	M	M	H	M
118	Deadwood-Clallam, deep families assn., 50 to 90 % slopes	residuum weathered from metamorphic rock	extremely gravelly loam	41	L	L	H	L
122	Dubakella family, 30 to 70 % slopes	residuum weathered from serpentinite	silt loam	91	L	H	H	M
123	Endlich-Buell families assn., 15 to 70 % slopes	residuum weathered from gneiss	gravelly loam	122	M	M	H	M
124	Entic Xerumbrepts-Gerle family assn., 30 to 90 % slopes	residuum weathered from granite	gravelly loam	36	L	M	VH	M
127	Gerle family-Entic Xerumbrepts assn., 50 to 90 % slopes	residuum weathered from granite	gravelly fine sandy loam	89	M	M	VH	M
128	Gilligan-Chawanakee families assn., 30 to 90 % slopes	residuum weathered from granite	sandy loam	119	M	L	VH	H
129	Gilligan-Goldridge families assn., 30 to 90 % slopes	residuum weathered from granite	sandy loam	119	M	L	VH	H
130	Gilligan-Holland families assn., 15 to 70 % slopes	residuum weathered from granite	sandy loam	119	M	L	VH	H
138	Holland family, 15 to 50 % slopes	residuum weathered from igneous and metamorphic rock	gravelly loam	201	H	M	H	M
141	Holland-Clallam, deep-Coboc families assns., 15 to 70 %	residuum weathered from igneous and metamorphic	gravelly loam	152	M	M	H	M

	slopes	rock						
142	Holland-Gilligan families assn., 30 to 90 % slopes	residuum weathered from igneous and metamorphic rock	gravelly loam	152	M	M	VH	M
143	Holland-Skalan families assn., 15 to 30 % slopes	residuum weathered from igneous and metamorphic rock	gravelly loam	152	H	M	H	M
150	Jayar-Woodsey families assn., 30 to 70 % slopes	residuum weathered from igneous and metamorphic rock	very gravelly loam	86	M	M	H	L
157	Lithic ruptic-Xerochreptic haploxerafs-Olete family assn., 30 to 90 % slopes	residuum weathered from peridotite	very gravelly loam	43	L	M	H	L
158	Lithic ruptic-Xerochreptic haploxerafs-Parks family assn., 30 to 90 % slopes	residuum weathered from peridotite	very gravelly loam	43	L	M	H	L
160	Lithic Xerorthents, granitic- Rock outcrop assn., 50 to 90 % slopes	residuum weathered from igneous rock	gravelly sandy loam	18	U*	L	VH	H
162	Lithic Xerumbrepts-Rock outcrop assn., 15 to 90 % slopes	residuum weathered from igneous rock	gravelly sandy loam	28	U*	L	VH	H
165	Nanny family, 2 to 30 % slopes	till	very gravelly sandy loam	201	M	L	M	M
168	Olete family-Lithic ruptic- Xerochreptic haploxerafs assn., 30 to 90 % slopes	residuum weathered from ultramafic rock	very gravelly loam	152	M	M	H	L
171	Parks family-Lithic ruptic- Xerochreptic haploxerafs assn., 30 to 90 % slopes	residuum weathered from ultramafic rock	gravelly fine sandy loam	94	L	M	H	H
174	Riverwash	sandy and gravelly alluvium		201	U*	L	L	H
176	Rogue-Jayar families assn., 30 to 50 % slopes	residuum weathered from granite	loamy sand	74	M	L	VH	H
183	Skalan-Clallam, deep-Decry families assn., 15 to 70 % slopes	residuum weathered from igneous and metamorphic rock	very gravelly loam	81	M	M	H	L
185	Skalan family-Lithic Mollic Haploxerafs association, 30 to 70 % slopes	residuum weathered from igneous and metamorphic rock	very gravelly loam	81	L	M	H	L
186	Tallac-Nanny families assn., 9 to 30 % slopes	residuum weathered from igneous and metamorphic	loam	201	M	M	M	M

		rock						
187	Tallac family-Ultic Haploxeralfs assn., 15 to 50 % slopes	residuum weathered from igneous and metamorphic rock	loam	64	M	M	M	M
197	Woodseye family-Rock outcrop assn., 50 to 90 % slopes	residuum weathered from metamorphic rock	very gravelly loam	48	U*	M	H	L
198	Woodseye-Jayar families assn., 30 to 70 % slopes	residuum weathered from metamorphic rock	very gravelly loam	48	L	M	H	L

* = Unproductive

Appendix D – Soil Condition Transect and Use Level Maps



Appendix D Continued – Soil Condition Transect and Use Level Maps

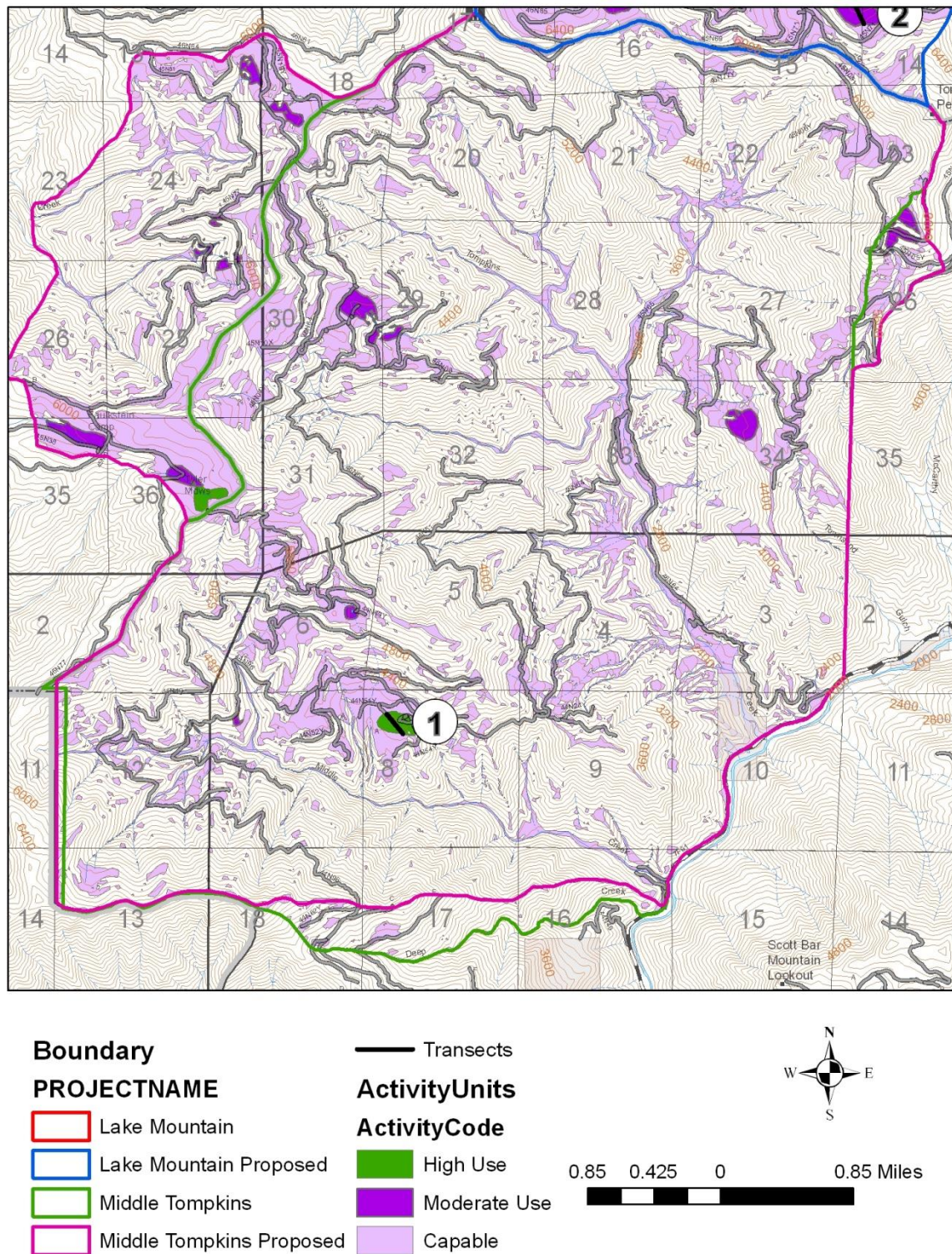


Figure 8. Soil Condition Transects and Use Level in the Middle Tompkins Allotment